

Appendix B

State of the Lakes Ecosystem Conference (SOLEC) Indicators

Indicators: Background

The State of the Lakes Ecosystem Conference (SOLEC) was established by the US and Canada in 1992 to hold biannual conferences to meet the reporting requirements of the Great Lakes Water Quality Agreement (GLWQA). SOLEC has led the effort to collect, develop and refine a set of science-based, not programmatic, indicators and taken an adaptive management approach to continually improve the effort.

In LaMP 2000, Chapter Three presented a cross walk of the SOLEC indicators and the Lake Michigan Lakewide Management Plan goals. In preparation for LaMP 2006, the LaMP Technical Coordinating Committee conducted a review of current SOLEC indicators in association with the Lake Michigan LaMP Goals. An extremely strong alignment was found to still be in place.

The Lake Michigan LaMP has also adopted the SOLEC sustainability target gauge to help provide a quick, summary visual of a measurement of where we are in achievement of the goal. For LaMP 2006, the titles at each end of the gauge have changed from good and poor to sustainable and unsustainable. It is hoped this action will help underscore the need to take action. In addition, following the "Status of the Goal" at the beginning of each chapter a list of indicator titles are included to inform the reader as to the data used to inform the status conclusion.

SOLEC Great Lakes Revised Indicator Framework

SOLEC has also been reviewing the indicators and has undergone a peer review process. A strong message that emerged from both internal and external Peer Review sessions was the need to reduce the overall number of indicators by identifying and eliminating those indicators that may be unnecessary or redundant. An additional and related comment was that in order to accomplish this reduction, categorical groupings of indicators by topic, issue or theme could be developed. Based on these recommendations, SOLEC organizers grouped related indicators into the following categories and sub-categories (or "bundles" and "sub-bundles") for ease in and presentation of related information and understanding of the larger issue:

1. Contamination
 - a. Nutrients
 - b. Toxics in Biota
 - c. Toxics in Media
 - d. Sources and Loadings
2. Biotic Communities
 - a. Fish
 - b. Birds
 - c. Mammals
 - d. Amphibians
 - e. Invertebrates
 - f. Plants
 - g. General
3. Invasive Species
 - a. Aquatic
 - b. Terrestrial

4. Coastal Zones
 - a. Nearshore Aquatic
 - b. Coastal Wetlands
 - c. Terrestrial
5. Aquatic Habitats
 - a. Open Lake
 - b. Groundwater
6. Human Health
7. Land Use - Land Cover
 - a. General
 - b. Forest Lands
 - c. Agricultural Lands
 - d. Urban/Suburban Lands
 - e. Protected Areas
8. Resource Utilization
9. Climate Change

In this approach, many indicators are relevant to more than one category. For example, "Contaminants in Sport Fish" is included in both "Contamination: Toxics in Biota" and "Human Health." All of the indicators within a category, however, contribute to a more complete evaluation of environmental conditions pertaining to that category.

Other categories are possible, and they may of greater usefulness in the future. Likewise, the "old" categories previously used for reporting Great Lakes indicators may still be relevant for some users. As originally conceived, the Great Lakes suite of indicators was developed around the topics of open and nearshore waters, coastal wetlands, nearshore terrestrial, land use, human health, societal, and unbounded. Each indicator was associated with one primary category, but all the indicators were also evaluated for relevancy to other SOLEC categories and to other major environmental groupings (e.g., land, water, air, biota), issues (e.g., contaminants, invasive species, urban sprawl), or indicator systems (e.g., IJC Desired Outcomes, Great Lakes Water Quality Agreement Impaired Beneficial Uses).

The categories currently listed are incomplete, and others may be incorporated in the future. For example, under "Aquatic Habitats," indicators have yet to be identified and developed for inland surface waters, including tributaries, inland lakes, and inland wetlands. The category "Resource Utilization" is also very incomplete and will require quite extensive consideration of socio-economic indicators relevant to the assessment of Great Lakes ecosystem components. Likewise, "Human Health" could be expanded to "Human Health and Well Being" and include indicators to assess social values of residents in the Great Lakes basin.

Changes to the Indicator Assessment Process

In response to suggestions from the peer reviews that the SOLEC process for the assessment of indicators was not sufficiently transparent or standardized, some changes were made to make assessments more credible and internally consistent. Previously, the available assessment options were restricted to Good, Mixed Improving, Mixed, Mixed Deteriorating, and Poor. These were not always sufficient or helpful. For SOLEC 2004, a system is being used to better express the relative condition and trend for all indicators. Authors have

provided a qualitative assessment for their adopted as they have done in the past, but the assessment categories are now less ambiguous. Specifically, authors have provided a “condition” of the ecosystem related to their indicator by selecting a “good, fair, poor or mixed” status and then assigning a “direction” of “improving, unchanged, deteriorating or undetermined” to each indicator.

Four broad ranking categories were used to characterize the assessments:

- Good. The state of the ecosystem component(s) is/are presently meeting ecosystem objectives or otherwise is in acceptable condition.
- Fair. The ecosystem component(s) is/are currently exhibiting minimally acceptable conditions, but it is not meeting established ecosystem objectives, criteria, or other characteristics of fully acceptable conditions.
- Poor. The ecosystem component(s) is/are severely negatively impacted and it does not display even minimally acceptable conditions.
- Mixed. The ecosystem component(s) displays both good and degraded features.

In addition, four ecosystem trajectories (or trends over time) were recognized:

- Improving. Information provided by the report shows the ecosystem component(s) to be changing toward more acceptable conditions.
- Unchanging. Information provided by the report shows the ecosystem component(s) is/are neither getting better nor worse.
- Deteriorating. Information provided by the report shows the ecosystem component(s) to be changing away from acceptable conditions.
- Undetermined. Data are not available to assess the ecosystem component(s) over time, so no trend can be identified.

For Lake Michigan: Sustainability would be beyond meeting ecosystem objectives and would include a system to maintain that status which might include monitoring, a watershed plan and local or state programs or regulations to prevent regression and the ability to address new issues should they occur.

Indicator Number	Bundle	Status
	CONTAMINATION	
	Nutrients	
111	Phosphorus Concentrations and Loadings	No change
4860	Phosphorus and Nitrogen Levels (Coastal Wetlands)	No change
7061	Nutrient Management Plans	Proposed at 2002
	Toxics in Biota	
114	Contaminants in Young-of-the-Year Spottail Shiners	No change
115	Contaminants in Colonial Nesting Waterbirds	No change
121	Contaminants in Whole Fish	Proposed at 2002. Revised description
124	External Anomaly Prevalence Index for Nearshore Fish	Proposed at 2002. Replaces 101
4177	Biologic Markers of Human Exposure to Persistent Chemicals	New title. Revised description
4201	Contaminants in Sport Fish	New indicator. Replaces 113 & 4083. New description
4506	Contaminants in Snapping Turtle Eggs	Revised description
8135	Contaminants Affecting Productivity of Bald Eagles	Revised description needed
8147	Contaminants Affecting the American Otter	Revised description needed
	Toxics in Media	
117	Atmospheric Deposition of Toxic Chemicals	No change
118	Toxic Chemical Concentrations in Offshore Waters	No change
119	Concentrations of Contaminants in Sediment Cores	No change
4175	Drinking Water Quality	Revised description
4202	Air Quality	New indicator. Replaces 4176. New description
9000	Acid Rain	No change
	Sources and Loadings	
117	Atmospheric Deposition of Toxic Chemicals	No change
4202	Air Quality	New indicator. Replaces 4176. New description
9000	Acid Rain	No change

Indicator Number	Bundle	Status
	BIOTIC COMMUNITIES	
	Fish	
8	Salmon and Trout	No change
9	Walleye	No change
17	Preyfish Populations and Communities	New title
93	Lake Trout	Revised description
125	Status of Lake Sturgeon in the Great Lakes	Proposed at 2002
4502	Coastal Wetland Fish Community Health	Revised description
	Birds	
115	Contaminants in Colonial Nesting Waterbirds	No change
4507	Wetland Dependent Bird Diversity and Abundance	New title. Revised description
8135	Contaminants Affecting Productivity of Bald Eagles	Revised description needed
8150	Breeding Bird Diversity and Abundance	No change
	Mammals	
8147	Contaminants Affecting the American Otter	Revised description needed
	Amphibians	
4504	Coastal Wetland Amphibian Diversity and Abundance	New title. Revised description
7103	Groundwater Dependent Animal and Plant Communities	Proposed at 2002. Revised description
	Invertebrates	
68	Native Freshwater Mussels	No change
104	Benthos Diversity and Abundance	No change
116	Zooplankton Populations	Revised description needed
122	Hexagenia	No change
123	Benthic Amphipod (Diporeia spp.)	No change
4501	Coastal Wetland Invertebrate Community Health	Revised description
	Plants	
109	Phytoplankton Populations	Revised description needed.
4862	Coastal Wetland Plant Community Health	New indicator. Replaces #4513. New description
8162	Health of Terrestrial Plant Communities	Proposed at 2002.
8500	Forest Lands - Conservation of Biological Diversity	New indicator. Description available
	General	
8114	Habitat Fragmentation	No change
8137	Nearshore Species Diversity and Stability	No action taken
8161	Threatened Species	No change
8163	Status and Protection of Special Places and Species	Proposed at 2002. No action
	INVASIVE SPECIES	
	Aquatic	
18	Sea Lamprey	No change
9002	Non-Native Species (Aquatic)	New indicator. Need description
	Terrestrial	
9002	Non-Native Species (Terrestrial)	New indicator. Need description

Indicator Number	Bundle	Status
	COASTAL ZONES	
	Nearshore Aquatic	
6	Fish Habitat	No action taken
4860	Phosphorus and Nitrogen Levels (Coastal Wetlands)	No change
4861	Effect of Water Levels Fluctuations	No change
4864	Human Impact Measures (Coastal Wetlands)	New indicator. New description
8131	Extent of Hardened Shoreline	No change
8142	Sediment Available for Coastal Nourishment	No action taken
8146	Artificial Coastal Structures	No change
	Coastal Wetlands	
4501	Coastal Wetland Invertebrate Community Health	Revised description
4502	Coastal Wetland Fish Community Health	Revised description
4504	Coastal Wetland Amphibian Diversity and Abundance	Revised description
4506	Contaminants in Snapping Turtle Eggs	Revised description
4507	Wetland Dependent Bird Diversity and Abundance	New title. Revised description
4510	Coastal Wetland Area by Type	Revised description
4511	Coastal Wetland Restored Area by Type	Revised description
4516	Sediment Flowing into Coastal Wetlands	No action taken
4860	Phosphorus and Nitrogen Levels	No change
4861	Effect of Water Levels Fluctuations	No change
4862	Coastal Wetland Plant Community Health	New indicator. Replaces #4513. New description
4863	Land Cover Adjacent to Wetlands (Coastal Wetlands)	New indicator. New description
4864	Human Impact Measures	New indicator. New description
	Terrestrial	
4861	Effect of Water Levels Fluctuations	No change
4864	Human Impact Measures	New indicator. New description
8129	Area, Quality, and Protection of Special Lakeshore Communities - Alvars	Revised description needed
8129	Area, Quality, and Protection of Special Lakeshore Communities - Islands	Revised description needed
8129	Area, Quality, and Protection of Special Lakeshore Communities - Cobble Beaches	Revised description needed
8129	Area, Quality, and Protection of Special Lakeshore Communities - Sand Dunes	Revised description needed
8131	Extent of Hardened Shoreline	No change
8132	Nearshore Land Use	No action taken
8136	Extent and Quality of Nearshore Natural Land Cover	No action taken
8137	Nearshore Species Diversity and Stability	No action taken
8142	Sediment Available for Coastal Nourishment	No action taken
8149	Protected Nearshore Areas	No action taken

Indicator Number	Bundle	Status
	AQUATIC HABITATS	
	Open Lake	
6	Fish Habitat	No action taken
111	Phosphorus Concentration and Loadings	No change
118	Toxic Chemical Concentrations in Offshore Waters	No change
119	Concentrations of Contaminants in Sediment Cores	No change
8131	Extent of Hardened Shoreline	No change
8142	Sediment Available for Coastal Nourishment	No action taken
8146	Artificial Coastal Structures	No change
	Groundwater	
7100	Natural Groundwater Quality and Human-Induced Changes	Proposed at 2002. Revised description
7101	Groundwater and Land: Use and Intensity	Proposed at 2002. Revised description
7102	Base Flow due to Groundwater Discharge	Proposed at 2002. Revised description
7103	Groundwater Dependent Plant and Animal Communities	Proposed at 2002. Revised description
	HUMAN HEALTH	
4175	Drinking Water Quality	Revised description
4177	Biologic Markers of Human Exposure to Persistent Chemicals	New title. Revised description
4179	Geographic Patterns and Trends in Disease Incidence	No change
4200	Beach Advisories, Posting and Closures	New indicator. Replaces 4081. New description
4201	Contaminants in Sport Fish	New indicator. Replaces 113 & 4083. New description
4202	Air Quality	New indicator. Replaces 4176. New description
	RESOURCE UTILIZATION	
3514	Commercial / Industrial Eco-Efficiency	Proposed at 2002
3516	Household Stormwater Recycling	Proposed at 2002
7043	Economic Prosperity	Revised description needed
7056	Water Withdrawal	No change
7057	Energy Consumption	No change
7060	Solid Waste Generation	Revised description needed
7064	Vehicle Use	Proposed at 2002. Replaces 7012. No action taken
	CLIMATE CHANGE	
4858	Climate Change: Ice Duration on the Great Lakes	No change
9003	Climate Change: Effect on Crop Heat Units	Proposed at 2002

Indicator Number	Bundle	Status
	LAND USE- LAND COVER	
	General	
4863	Land Use Adjacent to Wetlands (Coastal Wetlands)	New indicator. New description
7002	Land Cover - Land Conversion	Revised description needed
7101	Groundwater and Land: Use and Intensity	Proposed at 2002. Revised description
8114	Habitat Fragmentation	No change
8132	Nearshore Land Use	No action taken
8136	Extent and Quality of Nearshore Natural Land Cover	No action taken
	Forest Lands	
8500	Forest Lands- Conservation of Biological Diversity	New indicator. New description
8501	Maintenance and Productive Capacity of Forest Ecosystems	New indicator. Description needed
8502	Maintenance and Forest Ecosystem Health and Vitality	New indicator. Description needed
8503	Forest Lands- Conservation and Maintenance of Soil and Water Resources	New indicator. Description needed
	Agricultural Lands	
7028	Sustainable Agriculture Practices	No action taken
7061	Nutrient Management Plans	Proposed at 2002
7062	Integrated Pest Management	Proposed at 2002
	Urban/Suburban Lands	
7000	Urban Density	Revised description needed
7006	Brownfield Redevelopment	Revised description needed
7054	Ground Surface Hardening	Revised description needed
	Protected Areas	
8129	Area, Quality, and Protection of Special Lakeshore Communities - Alvars	Revised description needed
8129	Area, Quality, and Protection of Special Lakeshore Communities - Cobble Beaches	Revised description needed
8129	Area, Quality, and Protection of Special Lakeshore Communities - Islands	Revised description needed
8129	Area, Quality, and Protection of Special Lakeshore Communities - Sand Dunes	Revised description needed
8149	Protected Nearshore Areas	No action taken
8163	Status and Protection of Special Places and Species	Proposed at 2002. No action taken

Proposed Indicators with Descriptions and Sample Reports

SOLEC is a continually evolving process and proposals for new indicators are accepted throughout the SOLEC cycle for presentation, critique and potential acceptance into the full suite of Great Lakes indicators. For SOLEC 2004, sample descriptions and/or sample reports for the proposed indicators in the table below were submitted to SOLEC organizers. The descriptions and reports themselves are included here. Please provide any comments to SOLEC organizers.

Proposed Indicators	Status
Wastewater Treatment	sample description and report; proposed to replace #7059 & #7063
The following indicators are grouped under the new proposed <i>Well Being</i> Indicator Suite:	
Value of the Great Lakes to Basin Residents	sample description
Sense of Place: Indian Tribes Around the Great Lakes Basin	sample description and report
National Park Visitation	sample description and report
Capacity of Federal Program for Great Lakes Priorities	sample description
Public Recreational Access to the Great Lakes	sample description
Access to Information about the Great Lakes	sample description
Research/Educational Opportunities	sample description
Population and Income Distribution	sample description